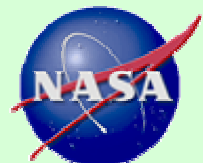


AROTAL

Measurement Capabilities

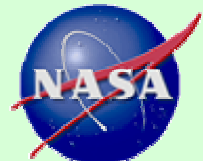
T. McGee, L. Twigg, G Sumnicht
GSFC

C. Hostetler
LaRC

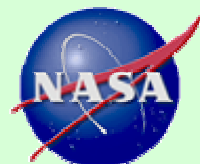
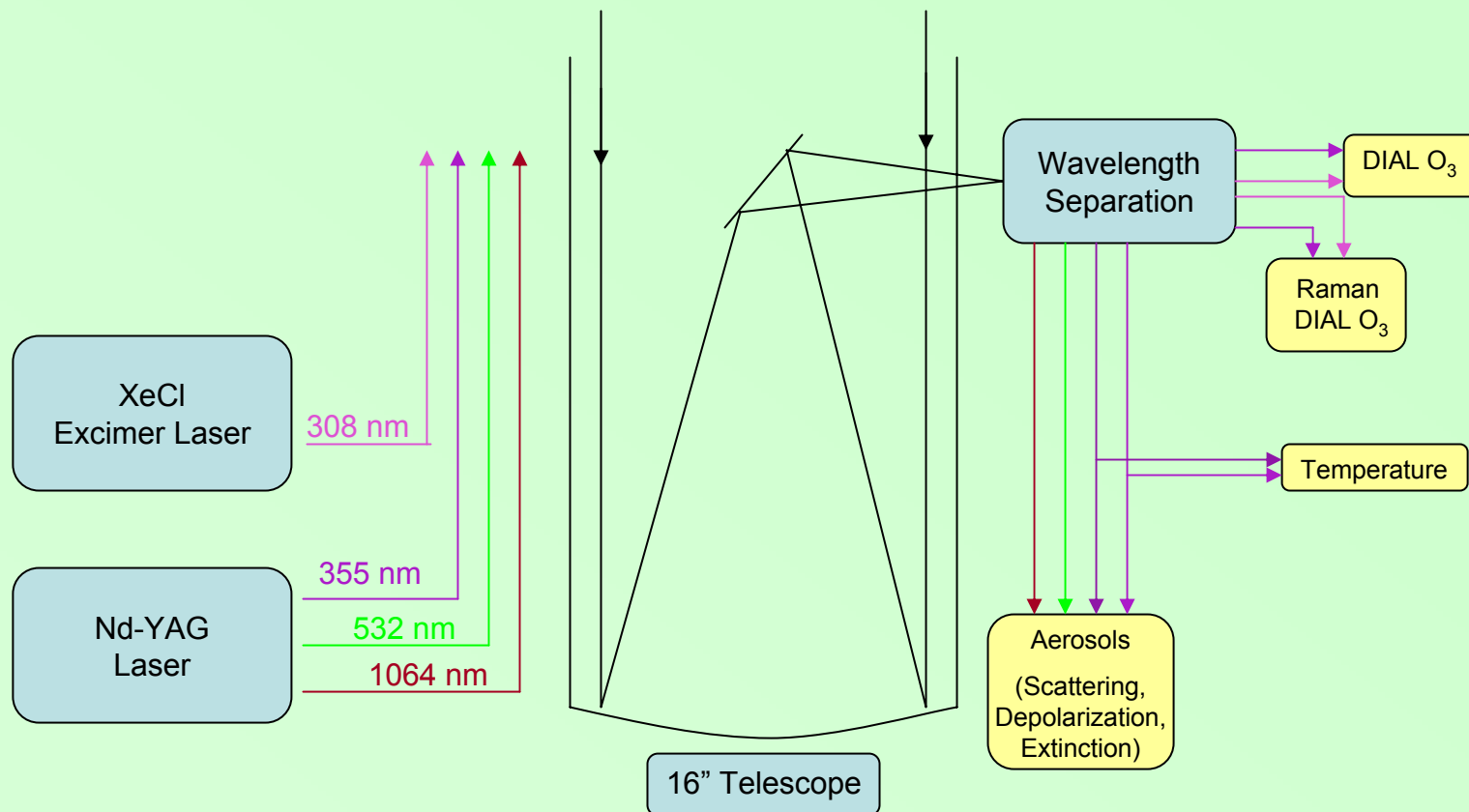


AROTAL – Airborne Raman Ozone, Temperature and Aerosol Lidar

- Combines Rayleigh Lidar, Differential Absorption Lidar (DIAL), and Raman DIAL
 - Zenith viewing
 - Measures: Ozone (DIAL and Raman DIAL), Temperature (Elastic and Raman Scattering), and Aerosols (UV backscatter and extinction)
 - Transmits 308 and 355 nm radiation (can also transmit 532 and 1064 nm)
 - Receives 308, 332 (N₂ Raman from 308), 355, 387 (N₂ Raman from 355)
 - Aerosol Backscatter at 1064 and 532 nm
 - Aerosol Depolarization at 532 nm
- } **LaRC Data Product**



AROTAL Schematic



Measurements

→ Ozone

- O_3 proportional to the difference of the slopes of the returns from 308 nm (absorbed by O_3) and 355 nm (not absorbed) – Differential Absorption (DIAL) technique

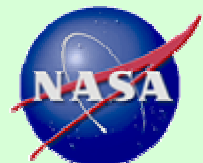
→ Temperature - $SZA > 91 - 92^\circ$

- 355 nm return is a relative density profile
- Assume hydrostatic equilibrium
- Initialize at high altitude with climatological temperature
- Integrate downward using Ideal Gas Law to extract temperature
- Converges in ~ 2 scale heights.
- Raman scattering can be used in regions of aerosols or optically thin clouds

→ Aerosols from UV Wavelengths

- Backscatter ratio from ratio of Elastic/Raman
- Extinction from elastic and Raman returns
- Klett retrieval with single wavelength

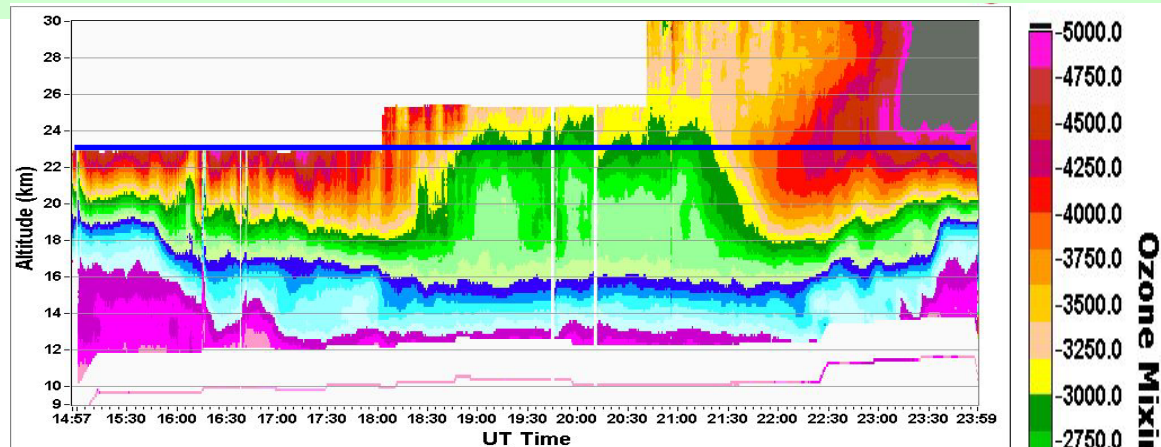
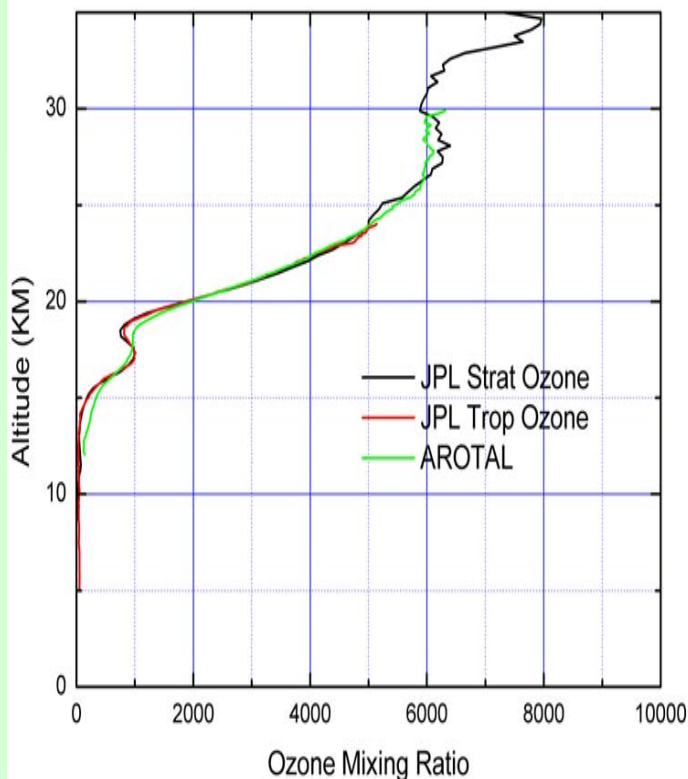
} $SZA > 97^\circ$



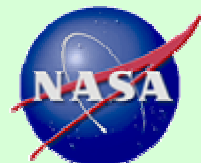
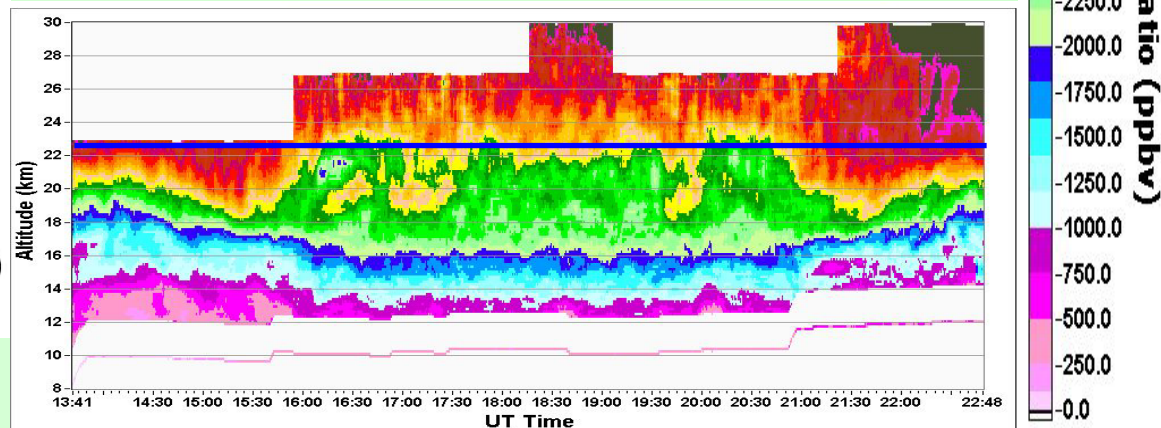
AROTAL Ozone Measurements during PAVE

January 27, 2005

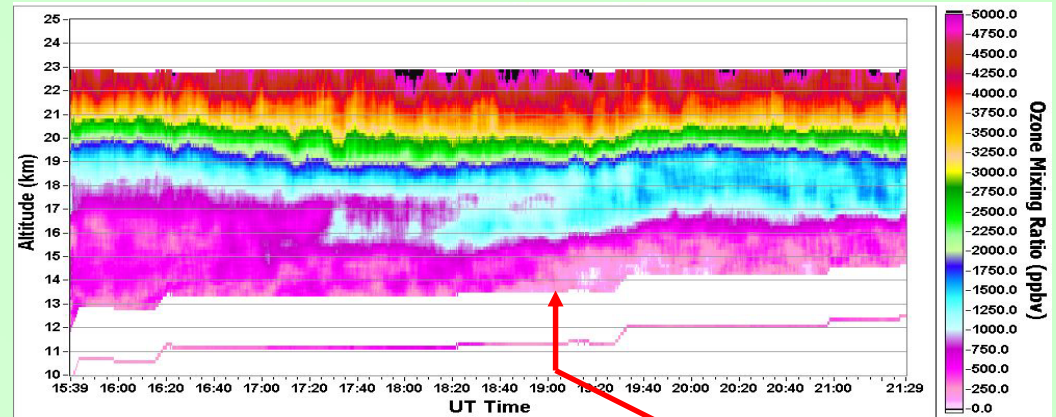
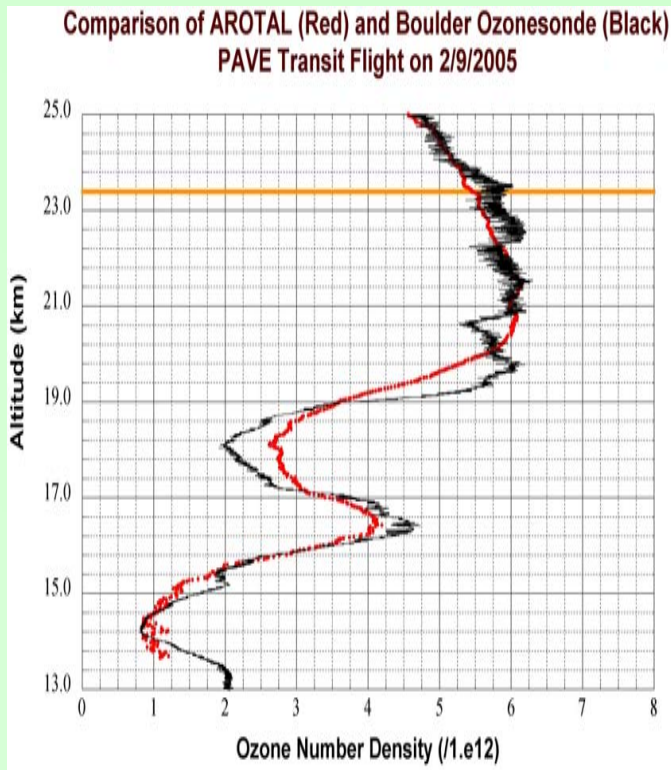
Jan 19 2005 TMF Lidar Comparison



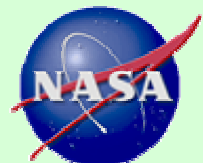
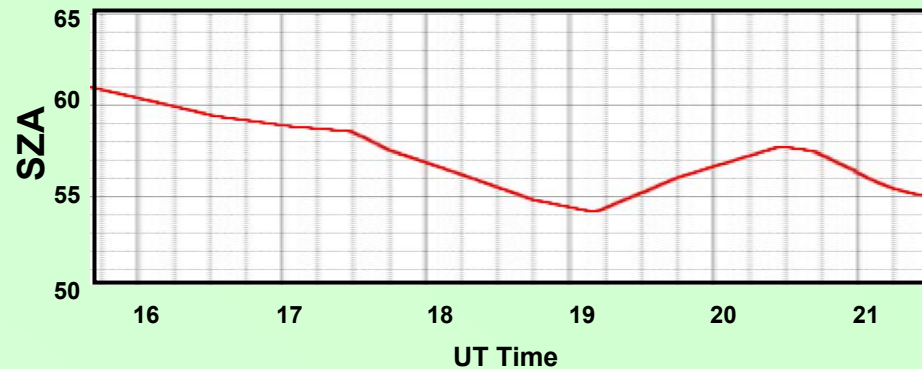
January 31, 2005



February 9, 2005 Transit Flight



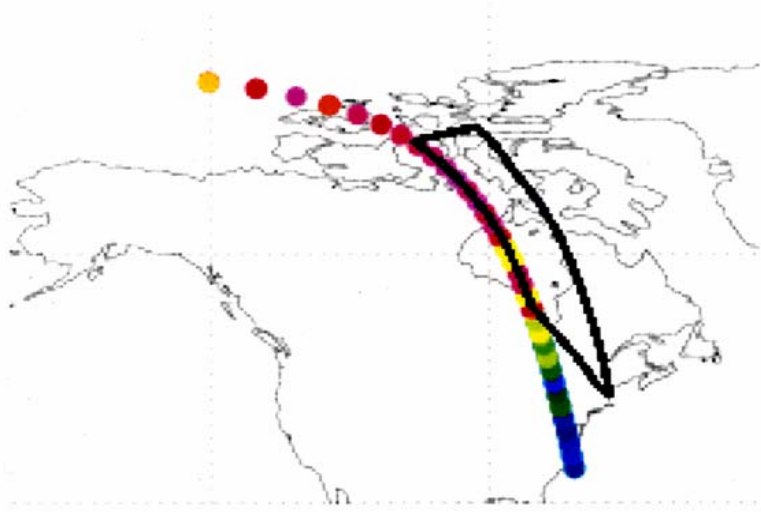
Approximate Boulder Overpass



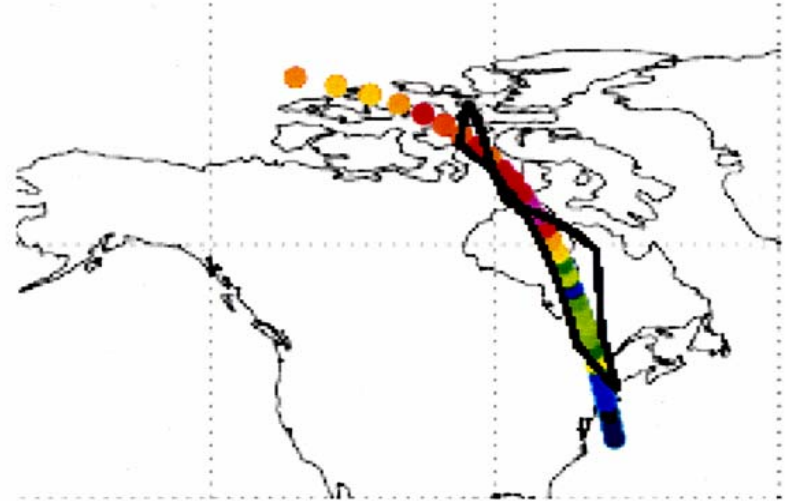
PAVE – MLS Flight Tracks

The DC8 flew from Portsmouth, North and deep into the vortex along the satellite track (MLS or TES track) on Jan. 27, 31, and Feb. 5, 2005.

- DC8 did not go as far North on Jan. 29, and other day(s).



Jan. 27

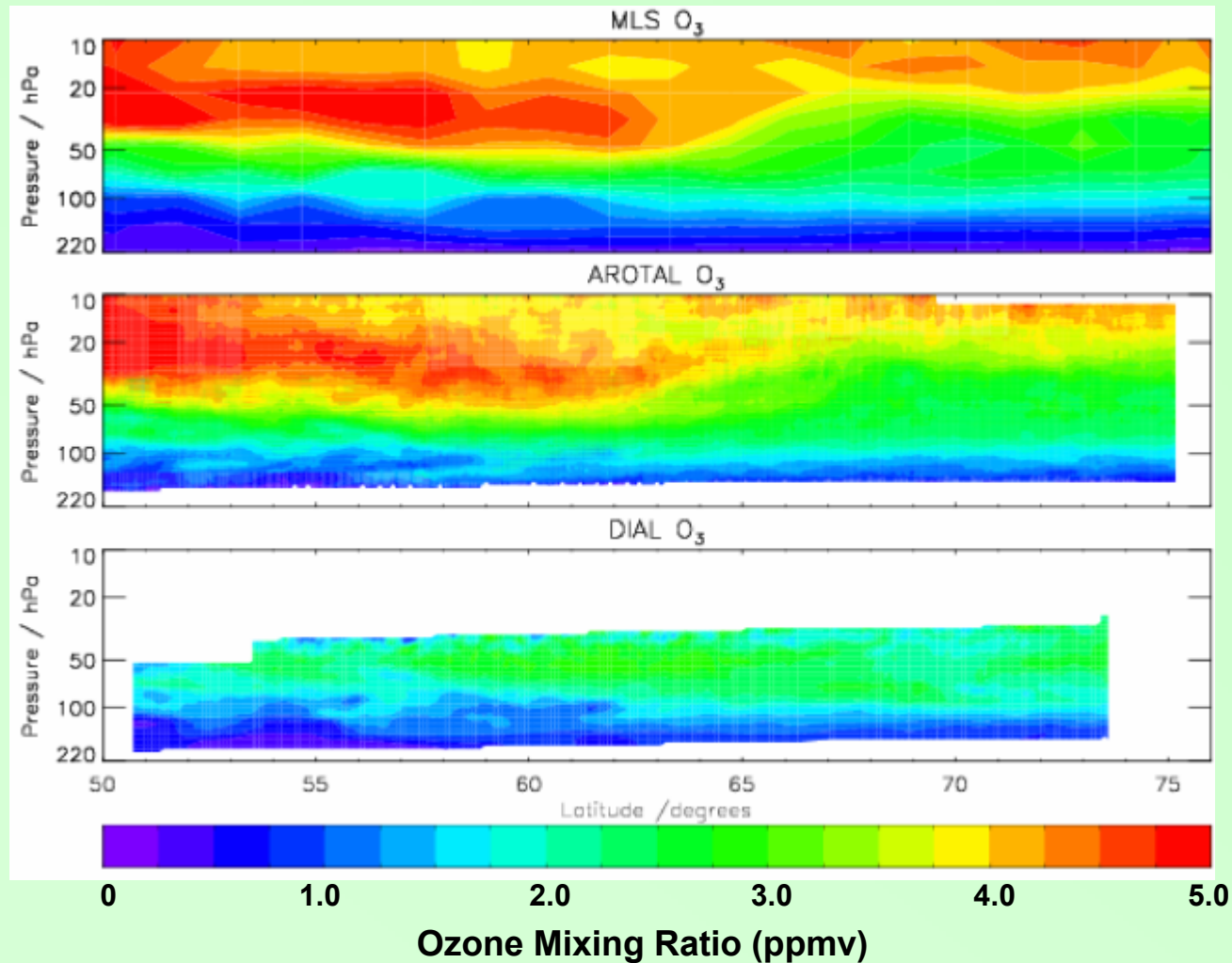


Jan. 31

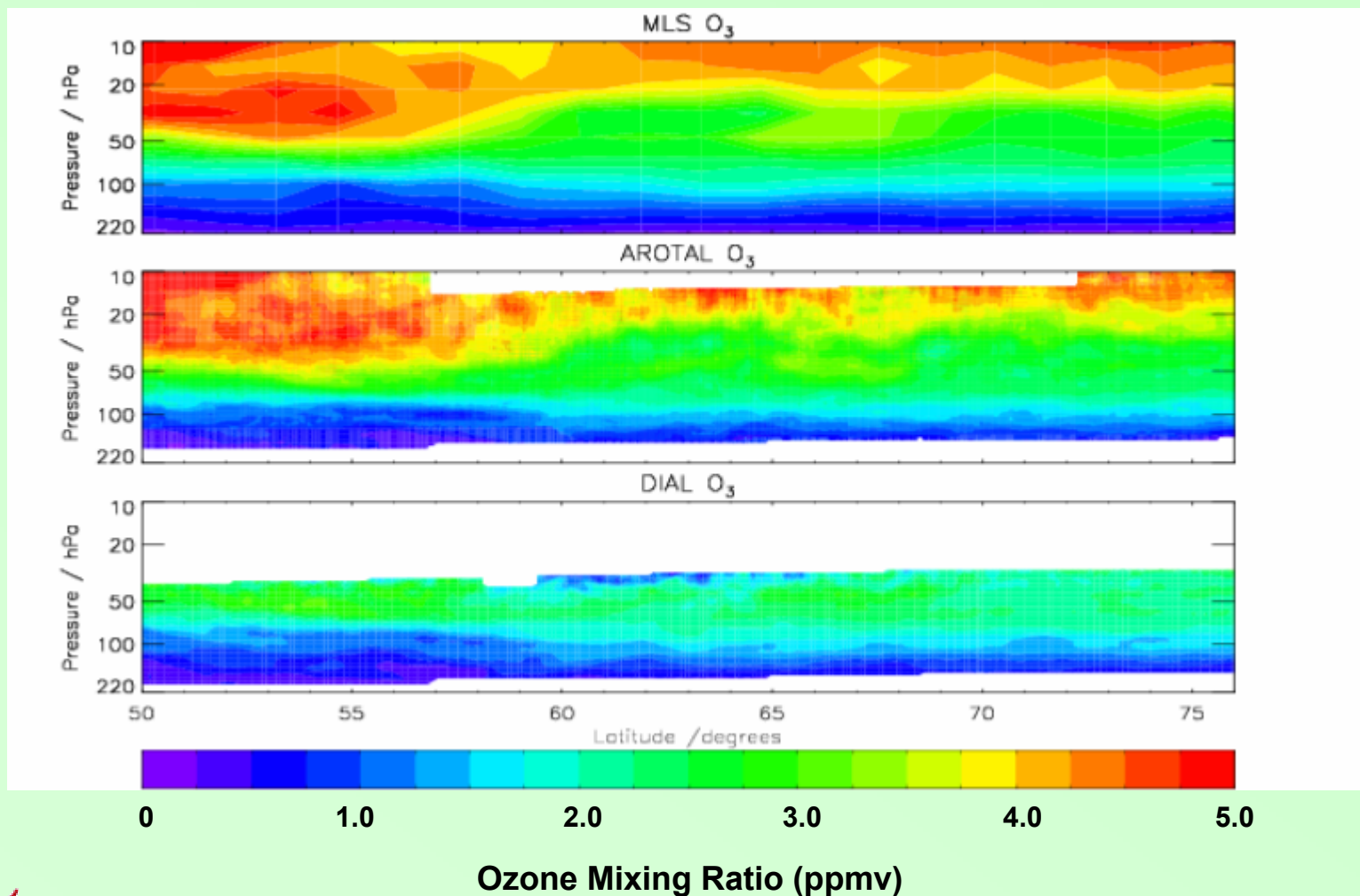
MLS profiles in color.

DC-8 track in black.

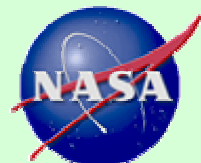
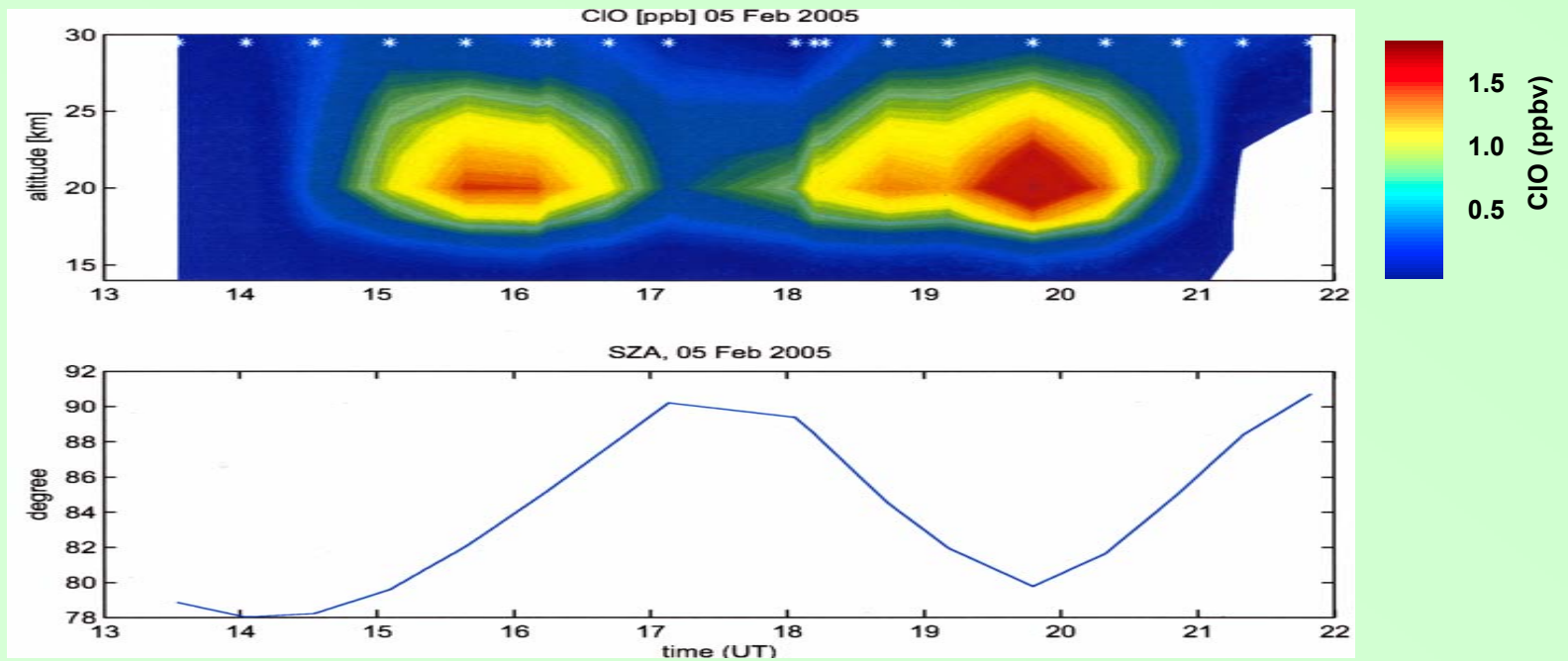
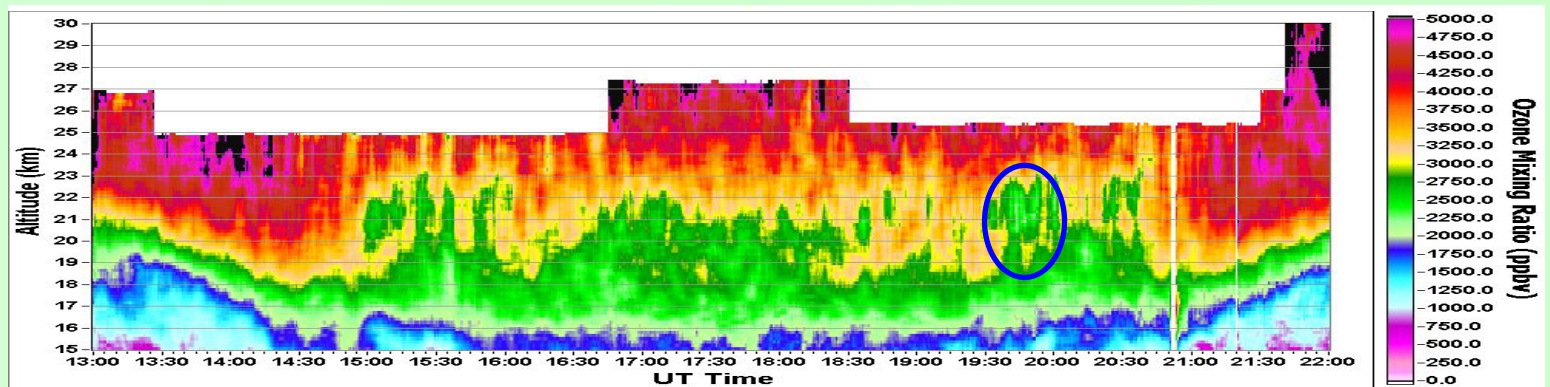
O3 MLS Validation Results: PAVE 2005 Preliminary Data January 27, 2005



O3 MLS Validation Results: PAVE 205 Preliminary Data January 31, 2005

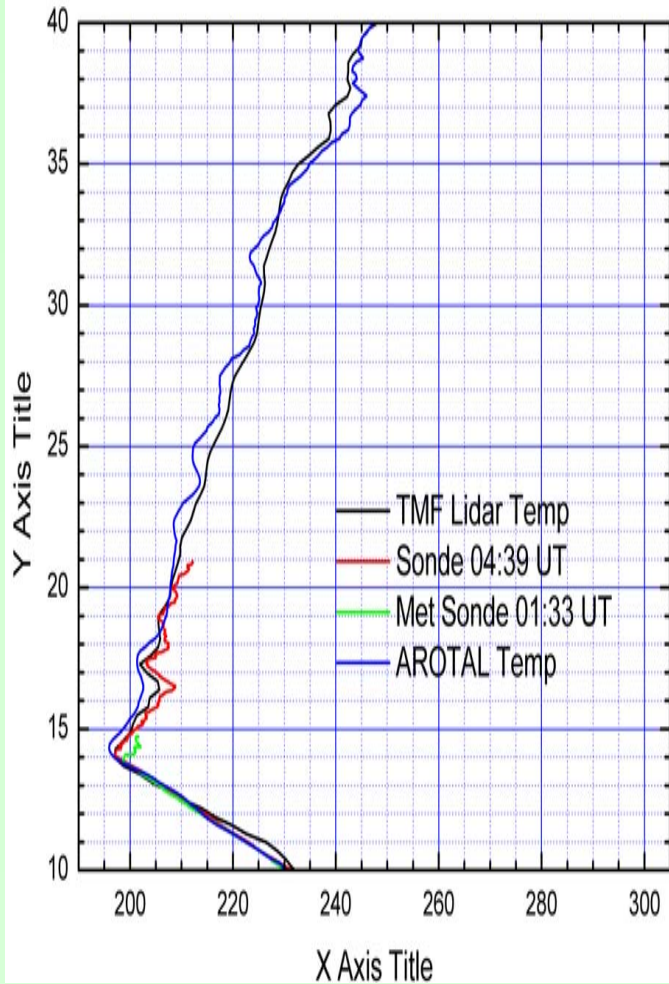


AROTAL – ASUR Feb. 5, 2005

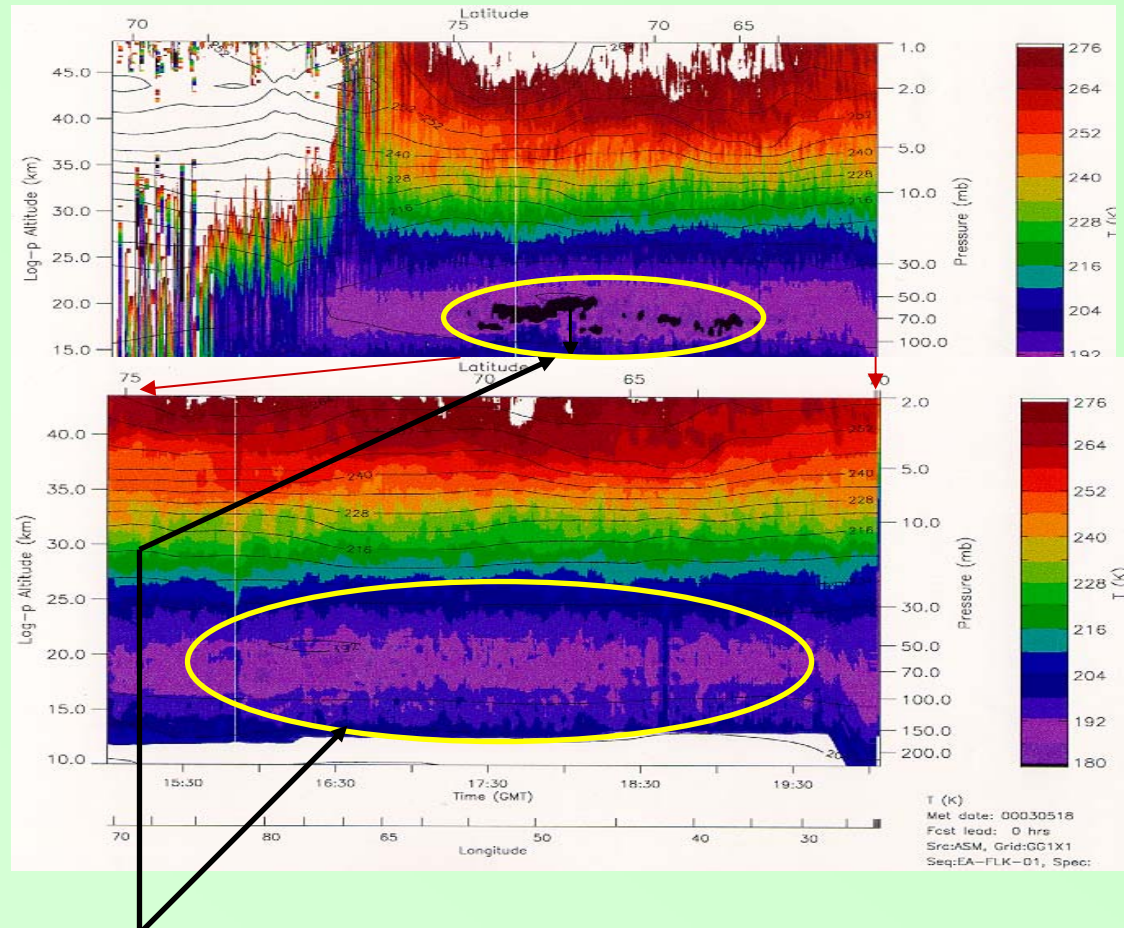


Temperature

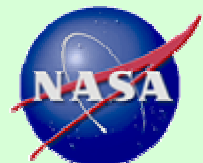
Jan 19 2005 TMF Lidar Comparison



March 5, 2000 (SOLVE)



"Contamination" from psc's removed by use of Raman returns



Conclusions

- ➔ AROTAL has demonstrated the capability to measure ozone profiles at solar zenith angles $< 55^\circ$ (lowest SZA during the PAVE mission was around 50°), and is extremely useful for validation of daylight Aura ozone measurements in the stratosphere.
- ➔ The maximum, reliable altitude of the retrieved profiles is still being determined, but is at least 23 km as demonstrated by the Boulder sonde comparison (11 – 13 km above the aircraft flight altitude)
- ➔ Temperature and aerosol, as well as ozone retrieved from Raman scattering returns, remain measurements for nighttime observation

